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THE SMALL AIRCRAFT CARRIER: A RE-EVALUATION OF THE SEA CONTROL SHIP

A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

MASTER OF MILITARY ART AND SCIENCE

by

JOHN L. CANADAY, LCDR, USN
B.S., United States Naval Academy, 1978

Fort Leavenworth, Kansas
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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

THE SMALL AIRCRAFT CARRIER: A RE-EVALUATION OF THE SEA CONTROL SHIP, by LCDR John L. Canaday, USN, 90 pages.

The question of how to meet our military obligations at home and abroad is necessarily answered from many viewpoints: tactical, technical, and financial. As the Navy faces serious cutbacks in its budget, the financial aspect increases in importance disproportionately over the other factors. Nevertheless, in an attempt to maximize the dollar without sacrificing efficiency, a review of alternative systems is now needed.

This study analyzes the low-end, low-technology, small aircraft carriers, called sea-control ships, as they have developed. Additionaly, it considers the research currently available as well as the considered opinions of leading naval experts. Using an historical approach, the study reviews these ships as they came into existence at the beginning of this century and pays particular attention to the World War II era where they were used effectively to replace more costly ships.

The study identifies situations where sea-control ships satisfactorily function and where they do not. It discusses modern technological developments which increase its potential, as port of a mixed force with the high-end, high-technology, large-deck carriers, and the future this type of ship may face.

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DEFINITIONS

A-6E - The DOD designation for an Attack aircraft (e.g. the A-6E Intruder.)

AAW - Anti-Air Warfare

AEW - Airborne Early Warning

AH-1T - The DOD designation for an Attack Helicopter (e.g. the AH-1T Sea Cobra.)

AMRAAM - Advanced Medium Range Air-to-Air Missile

AN/APS-20E - The Army/Navy Airborne Pulsed (Radar) Search system, model 20, fifth design modication.

ASW - Anti-Submarine Warfare

AV-8A/8B - The DOD designation for an Attack aircraft, Vertical Take-Off and Landing (e.g. the AV-8A and 8B Harrier and Harrier II.

AVG - Auxiliary Aviation Transport

CAM - The British Catapult Aircraft Merchant ship of World War II.

CAP - Combat Air Patrol

CH-53 D/E/F - The DOD designation for a Cargo Helicopter (e.g. the CH-53 Sea Stallion.)

CINC - Commander-in-Chief

CNO - Chief of Naval Operations

CTOL - Conventional Take-Off and Landing (aircraft)

CV - Multi-purpose Aircraft Carrier

CVA - Attack Aircraft Carrier

CVAN - Attack Aircraft Carrier (nuclear propulsion)

CVBG - Carrier Battle Group

CVE - Escort Aircraft Carrier

CVL - Light Aircraft Carrier

CVN - Multi-purpose Aircraft Carrier (nuclear propulsion)

CVNX - The tentative design for a new CVN design.

CVS - ASW Support Aircraft Carrier

CVV - Medium Aircraft Carrier

DOD - Department of Defense

F-8E - The DOD designation for a Fighter (e.g. the F-8E Crusader, F4F/FM Wildcat, F4U Corsair, F6F Hellcat, and F-14 Tomcat.)

F/A-18 - The DOD designation for a multi-purpose Fighter and Attack aircraft (e.g. the F/A-18 Hornet.)

FRS-1/2 - The British designation for a Fighter, Reconnaissance, Strike aircraft, Mark 1 & 2, the Sea Harrier.

GR-3/5 - The British designation for a Ground attack, Reconnaissance aircraft, Mark 3 & 5, the Harrier and Harrier II.

HMS - His or Her Majesty's Ship (Royal Navy)

HR2S-1W - The old Navy designation for a cargo helicopter, the HR2S/H-37, modified to carry an airborne radar.

ISCS - Interim Sea Control Ship

LAMPS - Light Airborne Multi-purpose System, a small helicopter, currently the SH-2 (LAMPS I) and SH-60B (LAMPS III), capable of ASW, OTH-T, and Surface Surveillance.

LHA - Amphibious Assault Ship (general-purpose)

LHD - Amphibious Assault Ship (multi-purpose)

LH-X - Tentative design for a new Amphibious Assault Ship

LPH - Amphibious Assault Ship

MAC - The British Merchant Aircraft Carrier of World War II

NATO - North Atlantic Treaty Organization

OTH-T - Over-the-Horizon Targetting

PAN - The French designation for a CVN

PH - The French designation for a helicopter carrier

RAF - Royal Air Force

SCS - Sea Control Ship

SH-3H - The DOD designation for an ASW Helicopter (e.g. the SH-3 Sea King, SH-2 Sea Sprite.)

SOSUS - Underwater hydrophone array, used in detecting submarines.

SSN - Attack Submarine (nuclear propulsion)

STO - Short Take-Off (aircraft)

STOVL - Short Take-Off and Vertical Landing (aircraft)

T-CBL - Tentative Conceptual Base Line, a basic design for a medium-sized aircraft carrier.

UH-1N - The DOD designation for a Utility Helicopter (e.g. the UH-1N Huey.)

URG - Underway Replenshment Group

USS - United States Ship

V-22 - The DOD designation for a Vertical Take-Off and Landing demonstrator aircraft, model 22, the Osprey.

VSTOL or V/STOL - Vertical or Short Take-Off and Landing (aircraft)

VSS - VSTOL or Aviation Support Ship

VTO - Vertical Take-Off (aircraft)

VTOL - Vertical Take-Off and Landing (aircraft)

V-VAC - The British Vickers Company's Versatile Aircraft Carrier design.

WOD - Wind-Over-the-Deck

XCV - The U.S. design for a merchant ship converted into an aircraft carrier, pre-World War II.

CHAPTER 1

INTRODUCTION

PURPOSE

The United States Navy is entering this decade with a tight budget, yet the threat to U.S. interests throughout the world remains. Somehow the Navy must maintain sufficient forces to meet the most dangerous threats despite the budget restrictions.

The problem has another dimension. Warship designs are continuously increasing in both size and complexity; the cost of new ships has risen to the point that fewer can be procured with each succeeding generation. Nevertheless, current policy is to continue building only ships of the highest quality. Congress, military analysts and even some Navy leaders are questioning this policy. They're asking whether the Navy can ever procure a sufficient number of "effective" ships to accomplish its missions world-wide. They're asking whether the Navy should change its policy and buy more ships of lower capability and cost.

In the early 1970's, the Chief of Naval Operations (CNO), Admiral Elmo Zumwalt, proposed a design and

procurement concept called "High-Low." He recommended that the Navy build new ships that would be moderately capable, less costly, and built in greater numbers than the existing highly capable but costly vessels. The new low-technology ships would complement, not replace, the existing high-technology ships. They would operate in lower threat areas, freeing high-technology ships to concentrate in the higher threat areas. One type of ship ADM Zumwalt proposed was the Sea Control Ship (SCS), a small, austere aircraft carrier. Congress did not approve construction, believing that this small carrier could not perform its designed mission.

This study is to analyze the U.S. Navy's small carrier proposals and designs of the last twenty years to evaluate whether the small carrier can perform the sea control mission for the Navy. Secondly, this study will evaluate some current small carriers of other navies to evaluate them against the U.S. Navy's designs. Finally, this study will evaluate small carrier operations during World War II, especially the escort carriers (CVE); the only conflict where both large and small carriers fought together. The purpose of this study is to determine whether a small carrier could effectively perform a mission or missions for the U.S. Navy.

BACKGROUND

There is no official definition of "large" or "small" aircraft carrier. In 1899, CAPT Alfred T. Mahan stated:

> A country can, or will pay only so much for its war fleet. That amount of money means so much aggregate tonnage. How shall that tonnage be allotted? ... Will you have a few very big ships, or more numerous medium ships? ... Between the two opposing demands there is doubtless a mean of individual size which will ensure the maximum offensive power *of the fleet*; for that, and not the maximum power of the single ship, is the true object of battleship construction.[1]

Although discussing battleship construction for the new steel Navy, Mahan's statement applies equally to modern aircraft carriers.

The first U.S. Navy aircraft carrier, the USS *Langley*, displaced only about 11,500 tons. The next two carriers, the USS *Lexington* and *Saratoga*, displaced about 33,000 tons each. Operations with the fourth carrier, the 14,500 ton USS *Ranger*, showed that it was too small and too slow to operate effectively with the fleet in the Pacific Ocean.[2] Consequently, in the mid-30's, the Navy determined that the minimum carrier size should be about 20,000 tons.[3] By the end of World War Two, the standard carrier was about 45,000 tons; now the standard is about 82,000 tons.

TABLE 1

WORLD WAR II ERA U.S. AIRCRAFT CARRIERS

CLASS	STANDARD DISPLACEMENT (Tons)	LENGTH	AIRCRAFT
Lexington	33,000	909'5"	80+
Ranger	14,500	769'	80+
Yorktown	19,900	809'6"	80+
Wasp	14,700	769'	80+
Essex	27,100	855'10"	80+
Midway	45,000	986'	100+
Independence	11,000	610'	33+
Sangamon	12,000	553'	21+
Commencement Bay	12,000	553'	21+
Long Island	8,000-8,333	492'	21+
Bogue / Prince William			

Sources: James C. Fahey, The Ships and Aircraft of the United States Fleet - 1939 1st Ed. (1939. Annapolis: Naval Institute Press, 1978), p. 7; ----- , The Ships and Aircraft of the United States Fleet Victory Ed. (1945. Annapolis: Naval Institute Press, 1978), p. 9; and Francis E. McMurtrie, ed., Jane's Fighting Ships 1947-48 (New York: The MacMillan Co., 1947), p. 33.

TABLE 2

CURRENT U.S. AIRCRAFT CARRIERS

CLASS	STANDARD DISPLACEMENT (Tons)	LENGTH	AIRCRAFT
Midway	56,000	979'	65
Forrestal	59,600	1071'	88
Kitty Hawk	60,100	1046'	88
J.F. Kennedy	61,000	1052'	88-90
Enterprise	75,700	1088'	88-90
Nimitz	81,600	1092'	88-90
T. Roosevelt	82,000	1092'	88-90
Iwo Jima (LPH)	17,000	602'3"	28 helos
Wasp (LHD)	28,000	844'	42

Sources: CAPT Richard Sharpe, RN, ed., Jane's Fighting Ships 1989-90 (Alexandria: Jane's Information Group Inc., 1989), pp. 480+; and Jean Labayle Couhat, ed., Combat Fleets of the World 1988/89 (Annapolis: Naval Institute Press, 1988), pp. 204+.

For purposes of this paper, a small aircraft carrier is any carrier with a smaller displacement than the current large-deck aircraft carrier for a given time period, designed to operate only VSTOL (Vertical or Short Take-Off and Landing) aircraft, and having sea control as its primary mission. The problem throughout the present design history of the small carrier is disagreement with this definition. Until the Navy, Congress and administration agree on any definition of a small carrier, like the one I proposed, the United States will not have any small carrier in peacetime. Instead, circumstances will again force us into building small carriers as we did in World War II.

U.S. NAVY MISSIONS

The National Security Act of 1947 defined the Navy's mission as: "Prompt and sustained combat incident to operations at sea." John F. Lehman, Jr., a naval aviator, naval analyst, and Secretary of the Navy for President Ronald Reagan, stated in 1978:

> The primary mission of the U.S. Navy is to ensure the unimpeded use of the seas by the United States and its allies in peace and if need be against hostile military attempts to deny such use. In war this mission also includes active denial to the enemy of the use of the seas, harbors, and adjacent airspace.[4]

From that quotation evolves the Navy's basic missions: sea control, power projection and strategic sealift. ADM Zumwalt defined sea control and power projection in 1976:

> The economy of the United States requires that she have a large maritime capability. The political interests and commitments of the United States require that she be capable of having a large military influence overseas. Both of those exigencies, in turn ... define the double mission of the U.S. Navy: to keep the seas open for commercial and military traffic of all kinds, which we call "sea control," and to make it possible to apply military power overseas, which we call "projection." ... without sea control the projection mission is impossible to carry out.[5]

ASSUMPTIONS

The nation's maritime interests and the missions of the U.S. Navy will not change substantially in the future. As a result, the Maritime Strategy, part of the National Military Strategy, will not change. The present strategy has remained relatively constant for 70 years, even in the present *era* of ***glasnost***, ***perestroika***, and the anti-drug war.

The Maritime Strategy will not change dramatically because it is designed to counter any threat to U.S. maritime interests, regardless of the potential adversary. The strategy identifies the most effective method(s) of employing the Navy to further national interests. It is not a doctrine or dogma set to a specific enemy, time frame, or threat capability. Although the Soviet threat may be reduced or entirely eliminated, our national interests have not changed and targets for any potential enemy remain the same.

In planning the Navy's employments, we can count on carrier-based air support from friends or allies only in NATO related operations in the North Atlantic and adjacent

seas. No other friendly or allied navy has any type of carrier and do not presently plan to build or buy them. This situation will not change in the future.

Lastly, there is no one existing alternative to the aircraft carrier (i.e. Star-Wars, satellites, etc.) Many systems could together replace some carrier capabilities (land-based patrol aircraft, warships, submarines, etc.) but so many of these systems would be required as to be cost prohibitive. This situation will not change in the near future.

CONCLUSIONS

The Navy does not have enough carriers for a world war. ADM C.A.H. Trost, the current CNO, while discussing the Navy's goal of 15 Carrier Battle Groups, recently said:

> The stated requirements of the CINC's [Commanders-in-Chief of Unified or Specified Commands] exceed this minimum force [15 deployable carriers] level markedly, as evidenced by their stated need for over 20 carrier battle groups.[6]

John F. Lehman stated in 1988:

> For purposes of deterrence, crisis management, and diplomacy, the navy [sic] must be present in the areas where they would have to fight if war broke out.... the navy [sic] must be able to deploy three times as many ships in wartime as in peacetime. Because the navy [sic] is assigned to five widely separated theaters - Atlantic/Caribbean, Mediterranean, Persian Gulf/Indian Ocean, western Pacific, and Pacific--those requirements produced the need for a minimum of fifteen aircraft carriers.[7]

A modern, large, nuclear-powered aircraft carrier requires between five and seven years to build. Building a

modern, small carrier can take as few as two to four years.[8] In a major crisis or war, lasting less than five to seven years, the Navy would receive no new, large-deck carriers and any carrier losses could not be replaced. The Navy can't build them quickly enough to participate. In addition, many carriers would need to be used in the sea control role, for which they are over-qualified, instead of strategic power projection, for which they are extremely well suited.

Now, with tighter budgets and improvements in VSTOL aircraft capabilities, Congress, the administration, and the Navy should re-evaluate the Sea Control Ship. The Navy needs to evaluate again whether the SCS can perform a mission or missions, allowing the Navy to maximize its ability to carry out its missions throughout the world.

The small carrier can effectively perform sea control tasks presently done by large carriers in the U.S. Navy. The small carriers cost less and take less time to build than their larger sisters. Modern VSTOL or STOVL (Short Take-Off and Vertical Landing) aircraft and helicopters operate very effectively from these carriers. A force of four to eight small carriers in the Navy would free the larger carriers to operate where the smaller carriers cannot.

METHODOLOGY AND LIMITATIONS

Chapter 2 analyzes the High-Low Concept and the SCS, to determine the capabilities and limitations of that small carrier; the chapter also looks at the aircraft which made the SCS possible. Chapter 3 analyzes the U.S. Navy's small carrier designs proposed after the High-Low Concept and SCS; compares these with the small carriers built by the British, French, Italian, Spanish and Soviet Navies since World War II; and looks at second generation VSTOLs. Chapter 4 analyzes the lessons learned from British and U.S. small carrier operations in World War Two, including the reasons they were built and their performance. This study will not address the U.S. budgeting process.

ENDNOTES

[1] CAPT Alfred T. Mahan, USN, Lessons of the War with Spain and Other Articles (Boston: Little, Brown and Co., 1899), pp. 37-39.

[2] Norman Friedman, LCDR Arnold S. Lott, USN (Ret) and HTC Robert F. Sumrall, USNR, USS Yorktown (CV-10), Ships Data No. 7 (Annapolis: Leeward Publications, Inc., 1977), p. 7.

[3] Stefan Terzibaschitsch, Aircraft Carriers of the U.S. Navy 2nd Ed. (Annapolis: Naval Institute Press, 1989), p. 44.

[4] John F. Lehman, Jr., Aircraft Carriers: The Real Choices The Washington Papers, 6, No. 52 (Beverly Hills and London: Sage Publications, 1978), p 15.

[5] ADM Elmo R. Zumwalt, Jr., USN (Ret), "High Low," US Naval Institute Proceedings, 102, No. 4 (1976), pp. 47-48.

[6] James D. Hessman and Vincent C. Thomas, "A Judgement on Military Priority," Sea Power, 32 (October 1989), p. 14.

[7] John F. Lehman, Jr., Command of the Seas (New York: Charles Scribner's Sons Macmillian Publishing Co., 1988), p. 172-173.

[8] Jean Labayle Couhat, ed., Combat Fleets of the World 1988/89 (Annapolis: Naval Institute Press, 1988), pp. 599+.

CHAPTER 2

THE HIGH--LOW CONCEPT AND THE SEA CONTROL SHIP

This chapter describes the rationale behind the High-Low Concept, the advances in technology that lead to the Sea Control Ship, the evaluation of the SCS concept, and the results. This chapter will show that the SCS can perform the sea control mission for the U.S. Navy.

BACKGROUND

ADM Elmo Zumwalt, who became the Chief of Naval Operations on 1 July, 1970, believed that the United States was experiencing a time of great military crisis. The U.S. was spending most of its defense budget on the Vietnam conflict, and the President and Congress refused to increase appropriations to match continuous Soviet military expansion. A large number of ships were reaching block obsolescence (where a large number of similiar ships--a block--become obsolescent within a few years), requiring either replacement or costly, short term repairs. Simultaneously, the Soviets were greatly increasing the size and sophistication of their fleet. To free funding for the

construction of new ships urgently required for the fleet, ADM Zumwalt accelerated the retirement of older ships.[1]

HIGH--LOW CONCEPT

Clearly no potential adversary can mount a high level threat simultaneously in all ocean areas. However, one could mount a graduated degree of pressure to our sea lanes or sea lines of communication (SLOCs) worldwide. Therefore, the Navy needs a mix of high and low capability ships to effectively cover the various threat areas. Otherwise, we can't provide the necessary worldwide protection of our sea lanes.[2]

With this knowledge, Naval planners developed a new ship design and procurement concept called "High-Low." "High" meant high-performance, highly capable ships and weapons systems that cost so much that the country can afford to build only a few. These ships have the great flexibility and versatility some missions require. "Low" meant moderate-performance, moderate-capability, moderate-cost ships and weapons systems that the Navy could turn out in relatively large numbers.[3] These ships have limited flexibility and versatility and are capable of performing only a few missions. These limited ships could do a specific mission, such as sea control, freeing the high-performance ship to perform the very demanding missions.

During World War II, the Navy operated its most capable ships in the Pacific to counter the heavy Japanese

naval threat. But even with almost unlimited funds and shipbuilding capacity, we found it necessary to build many small aircraft carriers to counter the wide-spread, predominately submarine threat posed by the Germans in the Atlantic. VADM Frank H. Price, director of Navy ship acquisition and improvements, testified to Congress in 1974:

> Had we built only large, highly capable platforms, we could not have built adequate numbers and could well have won the war in the Pacific, but lost the Battle of the Atlantic.[4]

Naval historian RADM Samuel E. Morison, while writing the History of United States Naval Operations in World War II, concluded that:

> ... Escort carrier groups were probably the greatest single contribution of the United States Navy to victory over enemy submarines.[5]

The High-Low Concept makes sense and will work only if the "low" end ship remains relatively small and austere. If the "low" end ship grows to a "high" end ship, it becomes too expensive and loses its advantage over the "high" end design. The following narrative indicates a troublesome tendency amoung Navy, Congressional, and administration planners to allow just that to happen.

NEED FOR MORE CARRIERS

After World War II, the Soviet's increased submarine technology led to the formation of special anti-submarine warfare (ASW) carrier groups.[6] The threat of high-speed submarine attacks also prompted the Navy to seek faster

surface ASW forces, including new fast escort carriers. The existing World War II era escort carriers were too slow to operate against the new threat. They were also too small to operate the newest ASW aircraft.

Three alternatives were considered: construct new CVEs, rebuild existing CVEs, or convert surplus large-deck *Essex*-class carriers--the solution actually adopted. Since the Navy knew that funding for sufficient numbers of new CVEs would be unlikely[7], they tried unsuccessfully to design a new ASW carrier in the mold of the old CVE. The money was just not available for the new design.[8]

HIGH COST OF LARGE CARRIERS

After the Korean War, all new carriers were "high-end," with the latest high technology incorporated. Each successive class had been larger, and more capable. As these new carriers became available, the older, less capable *Essex*es were relegated to the "low-end" mission of antisubmarine warfare (ASW) and were redesignated CVS.[9] Funds for a new escort carrier were even originally included in the FY53 budget, but withdrawn to pay for a large-deck carrier, the *Saratoga*.[10] By 1957, all of the previously "low-end" light (CVL) and escort (CVE) carriers had been retired.[11]

The Navy again attempted to procure a new escort carrier for FY68 construction. This time, the Secretary of Defense determined that there was no valid mission for this

type of ship, and withheld funding.[12] By 1970, it was evident the Navy could not continue building, or even maintaining, fifteen large carriers. Because the Navy was and is a multi-ocean force, ADM Zumwalt was convinced that to rely on this number of "high-end" carriers alone would be hazardous.[13]

THE HELICOPTER: TEMPORARY RELIEF

During the 1950's, there had never been enough CVSs for sea lane protection, and by the early 1970's there were no "low-end" carriers at all. The proposed solution was the helicopter. From the early 1950's onward, large, sonar-equipped ASW helicopters were a viable means of detecting and, perhaps more importantly, of keeping contact with a submarine. In particular, they could operate active (dipped) sonar randomly around the protected ship(s). While a submarine could detect and track a destroyer that was using active sonar, the helicopter could operate over a greater distance unpredictably. Also, a submarine-launched torpedo can't strike an airborne helicopter.

However, within a decade of 1959, advances in Soviet submarine "sound-quieting" techniques threatened to defeat the Navy's primary submarine detection means, underwater hydrophone arrays called SOSUS. Convoy tactics would have to be reintroduced by a navy sorely lacking the escorts. In 1969, the Navy's long range planners proposed small helicopter carriers as an equalizer. The proposal was to

modify some retired escort carriers while building some new ones. Planners envisaged a total of twenty-nine.

In theory the new helicopter carriers would replace the last of the CVSs. A single helicopter carrier could even replace a destroyer in the battle groups.[14]

THE HARRIER VSTOL: NEW CAPABILITY FOR SCS

British experience with small carriers and carrier aircraft in World War II showed the need for an aircraft capable of operating from small flight areas on the merchant ship in a possible future war. One result from this experience, the Vertical/ Short Take-off and Landing (VSTOL) aircraft, did not need the complex catapults and arresting gear of conventional naval aircraft. Consequently, these aircraft could operate on virtually any flat deck without costly modifications. The first proposals for such aircraft were made in the 1950's.[15]

In 1963, the P.1127 Kestrel, the Harrier's predecessor, successfully operated from the HMS *Ark Royal*. The first operational Harriers were produced in 1967 for the Royal Air Force, and the U.S. Marines purchased their first in FY71.[16]

Harriers have operated in heavy seas with the wind-over-the-deck (WOD) up to 40 knots. In addition:

> ... With moderate WOD and a 500-foot deck-run, the payload of weapons and fuel could be doubled compared with a Vtol operation, without catapults or other boost systems.[17] ... With a 10,000 lb load, a Harrier can leave a flat deck at 120 knots airspeed

> after a 600 ft run with a 25 knot wind down the deck.... a [15 degree] ski-jump reduces the safe lift-off speed to 70 knots and cuts the deck roll ... to just 200 ft.[18]

Naval aircraft, like ships, grew considerably in size and weight after World War II. In addition, the newer aircraft always required catapults, not always required previously. Consequently, carrier size increased to enable the ship to carry the new planes. The small Harrier can operate from virtually any flat deck available. Not only can it operate without catapults, but it also can operate without arresting gear--required since the 1920's. Therefore, the Harrier can fly from virtually any small-deck carrier, like the SCS.

SEA CONTROL SHIP

The "Low-end" aircraft carrier, called the Sea Control Ship (SCS), is a small, austere carrier designed to protect our sea lanes or sea lines of communication (SLOCs). With the individual cost so great, the Navy will never have more than twelve to fifteen large-deck carriers at one time. The administration's present goal is for fourteen carriers.[19] Norman Friedman, a noted naval analyst, stated in 1983:

> At present the U.S. carrier force is limited in numbers by the high cost of individual carrier battle groups. Although the plan to increase the force to sixteen ships may well be realized, that would still be far short of the number required.[20]

There are more SLOCs around the world than twelve to fifteen large-deck carriers can protect. The Atlantic Council Working Group on Securing the Seas wrote in 1979:

> Others have suggested that we cannot protect Atlantic and Indian Ocean sea lines of communications (SLOCs) simultaneously. Another frequent cause for concern is the dwindling of U.S. capabilities to defend the Western Pacific SLOCs to Japan during a NATO war... The U.S. Navy must respond to this threat and still remain within politically acceptable budget limits...[21]

Their specific recommendations included: "*Develop more threat-responsive Alliance naval capabilities by* creating numerically larger navies of less expensive ships...."[22]

The Navy has always had to tailor forces to meet the anticipated level of threat. As the Navy testified before Congress, the SCS would make that possible. The SCS would protect Underway Replenishment Groups (URGs), Amphibious Groups, merchant convoys, and Task Groups that are without carrier suppport, in areas with a low air threat. VADM Price continued:

> ... we have formulated a ship which can provide effective air support when the presence of a carrier is neither practical nor possible. Like the World War II escort carrier, or CVE, the SCS can be produced in sufficient numbers to provide the requisite protection in the many low threat open ocean areas.[23]

ADM Zumwalt wrote in 1976:

> Her price was to be 100 million 1973 dollars, about one-eighth the cost of a nuclear carrier. Her principal peacetime purpose was to show the flag in dangerous waters, especially the Mediterranean and the Western Pacific ... so that the big carriers ... could withdraw ... and deploy out of reach of an enemy first strike, thus putting themselves in a favorable position to respond to such a strike--and therefore to deter it.

> In a wartime situation the positions ... would be reversed: the big, powerful ones would fight their way into the most dangerous waters, destroying opposition beyond cruise missile range with their planes, and the sea control ships would serve in mid-ocean.[24]

We need more carriers to cover all the SLOCs and the large-deck carriers should not be used for that job. The twelve to fifteen large-deck carriers are needed in wartime for strategic power projection, including offensive ASW over long distances and at high speeds, air strikes against the enemy's fleet or shore facilities, close air support for ground battles, air superiority to counter air-launched attacks against ships and ports.

The large carriers have "far too much offensive capability to waste on convoy duty."[25] However, in any actual conflict, ADM Zumwalt continued:

> ...there might be at sea as many as 20 convoys of merchantmen, troop transports, and naval auxiliaries in need of air protection from the time they left the reach of land-based air until they entered areas where the deployed carriers were operating.... Eight vessels capable of that mid-ocean job could be built for the price of one full-fledged carrier, which in any case, if it was assigned to convoy duty, could protect only one convoy instead of eight. Moreover the SCS would be fast and easy to build.... Clearly SCS was a good investment...[26]

Norman Polmar, a noted naval analyst and participant in some of the planning, in 1977 wrote:

> The logic of this approach is valid. In fact, there does not appear to be any better alternative. The concept has been reaffirmed by Admiral Holloway and Secretaries of Defense Schlesinger and Rumsfeld.... There can be useful questioning of specific types with the high-low mix. For example, I questioned--before congressional committees and in print--the validity of the sea control ship. However, an additional, dedicated aviation ship of less capability (and cost) than the CVN was, and still is, required.[27]

SCS TESTING

The SCS concept was operationaly tested at sea aboard the USS *Guam* (LPH-9) from 1972 to 1974. The Commander, Operational Test and Evaluation Force, tested the concept on an Interim SCS (or ISCS), and concluded that the ISCS had--for an intensity far greater than that expected in wartime--demonstrated the capability:

> ...to continuously and simultaneously maintain two flank ASW sonobouy barriers and airborne surface surveillance, while concurrently prosecuting contacts as they occur.... The ISCS is fully able to support 14 SH-3H ASW helicopters (plus 3 AV-8A [Harrier] and 4 LAMPS).[28]

Although the SCS concept called for a limited general purpose ship, the testing concentrated on only one mission, ASW. Not addressed was:

> ...the *deterrent effect* of these multiple capabilities on the SSN's decision to press home an attack. Studies of wartime submarine actions suggest that the deterrent effect of the SCS systems may be equal to or greater than its killing effect.[29]

VADM Price continued:

> We consider that the concept is fully validated and that the design features will give us an effective, less expensive, but fully capable sea-based air support platform.... The SCS is the most cost effective means of replacing dwindling sea-based air support assets, those that are required in defense of our sea lines.[30]

STILL NO SCS

The first request for funds for the SCS, for $29.4 million, was in the FY74 budget. The plan was to request one in FY75, three in FY76, and then two per year for next

two FYs, for a total of eight SCSs. Ralph Preston, the chief counsel for the House Appropriations Committee, was against the SCS and swayed Rep. Mahon, the Chairman, against it--the House approved no money. Several senators of the Senate Appropriations Committee, including Senators McClellan and Young, strongly favored the SCS and the entire High-Low Concept--the Senate approved the $29.4 million. In conference, Congress agreed to retain, but freeze the money, pending a report by the General Accounting Office. The report, submitted after ADM Zumwalt retired, was negative.[31] "... Congress refused to fund SCS due to limited size, capability and speed ... "[32]

ADM Zumwalt blames ADM Rickover for the defeat of the SCS. Rickover completely disagreed with the idea of moderately capable ships and "was vehemently against non-nuclear propelled ships."[33] The naval aviation community was also against the SCS and VSTOL in the mistaken belief that they were intended to replace the large-deck carrier. Some of the opposition to the High-Low concept was "[Zumwalt was] not procuring the first-class warships absolutely necessary to meet a first-class Soviet threat."[34] The money frozen in the FY74 budget was reallocated for studies of a low-cost conventional carrier, intended to replace the large-deck carrier. These studies resulted in the medium aircraft carrier (CVV). The design of the SCS was sold to Spain in 1977, where, with some modifications, it was used to build the *Principe de Asturias*.[35]

Even while attempting to acquire the SCS, the Navy tried to put more ASW aircraft on carriers. First, 8 SH-3 ASW helicopters were added without the loss of any aircraft. This successful experiment led to the "flexible-carrier concept" implemented in 1970, with half an ASW air wing carried for the loss of twelve tactical aircraft. By FY77, all large-deck carriers had been equipped to carry this flexible air wing.[36] The flexible carrier concept led to the redesignation of the large-deck carriers from attack aircraft carriers (CVA/CVAN) to multi-purpose aircraft carriers (CV/CVN).

Although ADM Zumwalt was accused of trying to replace the large-deck carrier with something smaller, he was the prime supporter of the large-deck carrier and worked hard and successfully for the third *Nimitz*-class CVN, the *Carl Vinson* (CVAN/CVN-70).[37] Norman Friedman wrote in 1983:

> The beauty of the CV concept was that the ship could shift from a CVA air wing to a mixed (CV) air wing to an air wing with a full CVS load of ASW aircraft with full flexibility.... These CV conversions solved only half the CVS replacement problem, since clearly the big carriers would be far too valuable to waste on areas of low air threat in wartime. There had never been enough CVSs for sea lane protection, and now there were no low-value carriers at all.[38]

CONCLUSIONS

Since the end of World War II, changing threat technology forced the Navy to consider replacing the World War II era escort carriers in the ASW role because the escort carrier had proven valuable in low-threat missions.

The Navy determined it needed a large number of replacements due to the increasing threat, yet no small replacement could be designed and produced in sufficiently large numbers due to the change in ASW aircraft size.

Two factors changed the equation: the ASW helicopter and the Vertical/Short Take-off and Landing aircraft (VSTOL), the Harrier. The SCS, a small, relatively inexpensive, austere carrier was designed around these two new aircraft.

The Sea Control Ship was immediately controversial. The idea of an austere warship deeply troubled some, like ADM Rickover and the nuclear power community; others, like the naval aviation community, believed this ship might replace the large-deck carrier regardless; still others, like civilian naval analysts Norman Friedman and Norman Polmar, questioned the ship's entire mission.[39] Consequently, the SCS was not built by the U.S. Navy and no dedicated, fixed-wing-aircraft-capable ship exists to fill the mission of open-ocean ASW and convoy escort.

ENDNOTES

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[24] ADM Elmo R. Zumwalt, Jr., USN (Ret), "High Low," US Naval Institute Proceedings 102, No. 4 (1976), pp. 52-53.

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[29] Ibid., pp. 6-6 - 6-8.

[30] US Cong., House, Committee on Armed Services, pp. 1304-1305.

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CHAPTER 3

SMALL CARRIER DESIGNS SINCE HIGH--LOW

This chapter describes the continuing evolution, since the demise of the SCS, of the small carrier in the U.S. Navy and VSTOLs, and the small carrier designs built since World War II by several navies. This chapter shows that the U.S. and several other navies developed effective designs and the others built ships that are or would be effective Sea Control Ships.

BACKGROUND

The defeat of the Sea Control Ship in the mid-1970's failed to still the debate within the administration or Congress on the relative merits of small carriers. ADM Zumwalt and his planning group, architects of the small carrier, did not limit their attention to the SCS. They were also interested in another, larger design for sea control, a 40,000-ton design which ultimately grew to a 50,000- to 60,000-ton design. They proposed this second design, in addition to the SCS, as a small aircraft carrier.

The new design formed the basis of the Tentative Conceptual Base Line (T-CBL), which in turn, formed the

basis for all smaller than large-deck carrier discussions leading to the Carter Administration's medium aircraft carrier (CVV).[1] Some have used this second design to label ADM Zumwalt as anti-large-deck carrier. On the contrary, he was an advocate and major supporter of construction of the third *Nimitz*-class CVN, the *Carl Vinson* (CVN-70).[2]

In FY75 Congress denied a $143 million request to build the SCS prototype, citing DoD studies which doubted the SCS' ability to survive a submarine-launched torpedo or cruise missile attack. Instead, they allocated the frozen $29.4 million from the FY74 budget toward studies of a low-cost, conventional aircraft carrier, which became the CVV.[3] The questions about the small carriers ability to withstand damage reappears with every small carrier design. Norman Friedman wrote in 1983:

> Clearly a larger ship would be less vulnerable to many types of attack ... because the effect of any given weapon would occupy a smaller fraction of its length. On the other hand, some weapons are so destructive that no ship could be expected to survive.... a small carrier would not accommodate enough explosives to destroy the carrier, were she to suffer a magazine hit. The large magazines of a modern nuclear carrier can be likened to a dormant volcano.[4]

CARRIER REQUIREMENTS

The ongoing carrier debate centered on two major areas of concern during the Ford and Carter Administrations: the need for more carriers and the need to replace the aged *Midway*-class carriers. John F. Lehman wrote in 1978:

> Professional assessments by purely military war-fighting criteria settle at approximately 17 to 22 large carriers for superpower war-winning. Those based on peacetime deterrence settle at about 8 to 13.[5]

Norman Friedman continued:

> At present the U.S. carrier force is limited in numbers by the high cost of individual carrier battle groups. Although the plan to increase the force to sixteen ships may well be realized, that would still be far short of the number required.[6]

In 1975-1977, the three *Midway*-class carriers were fast nearing the end of their useful service lives. In FY78, the Navy proposed building a fifth nuclear carrier to replace a *Midway*-class carrier, with an additional one every two years to replace the *Forrestal*-class conventionally powered, large-deck carriers.[7]

MEDIUM AIRCRAFT CARRIER--THE CVV

In the summer of 1975, the Secretary of Defense directed that another study be conducted to produce a small aircraft carrier design. Originally a non-nuclear design, the Navy, citing all of the advantages of nuclear power, succeeded in having the design changed to a nuclear-propelled ship. Using the T-CBL as a starting point, the Navy designed a new carrier, called the CVNX. However, Friedman continued:

> ... after reviewing three alternative CVNX designs, a characteristics study group concluded in January 1976 that on the basis of a three-ship buy a fourth *Nimitz* was the best means of maintaining the thirteen-carrier force beyond 1985.[8]

Although the President requested funding for another *Nimitz*-class carrier in FY77, he later cancelled the request

because of criticism of his budget. Two smaller, conventionally-powered medium aircraft carriers, called CVVs, were requested in FY79 and FY81.[9] Congress had not supported the SCS due to its small size, limited capability and slow speed. Consequently, the Navy re-evaluated its requirements and developed designs more flexible to the range of "low-threat" operations. The result was:

> ... suitable for sea control, amphibious assault, close air support, mine countermeasures, low intensity AAW (primarily against long range reconnaissance, missile guidance aircraft). [The] multi-mission concept overcomes many previous Congressional objections.[10]

Harold Brown, Secretary of Defense, testified to Congress in 1977:

> ... The fiscal year 1977 budget contained $350 million for the long-lead-time elements of a fourth *Nimitz*-class nuclear carrier. However, the fiscal year 1978 budget submitted by the preceding administration omitted the rest of the funding for that ship. The 5-year shipbuilding plan submitted at that time included two smaller conventionally powered carriers, designated CVV, one in the fiscal year 1979 program, and one in the fiscal year 1981 program. The original intent was to design the CVV to handle only V/STOL aircraft.[11]

The Carter Administration supported the CVV program in general, but removed the requirement for only VSTOL aircraft. The CVV would now be capable of operating VSTOL and all the conventional aircraft in the Navy inventory, using catapults and arresting gear.

The Carter administration placed a higher priority on the Navy's sea control mission than on power projection. They determined that the number of carriers was as important, if not more important, than the number of

aircraft any one carrier could carry.[12] Secretary Brown continued:

> ... On the side of the fourth *Nimitz*--the obvious advantage would be the ability to steam for as long as you like, and at top speed if necessary, without concern for ... low propulsion fuel states. That advantage is clear, ...
>
> What could the two CVV's offer that might offset that advantage? One thing is that they could operate in two different parts of the world at the same time. For some tasks, that is a great advantage. And it could be very advantageous in the kind of sea-control mission we see for the immediate future.[13]

The Navy faces threats at sea from attacks by an enemy's ships, submarines, and aircraft. The carrier, using her aircraft, can defend herself from attack by all three and can effectively attack them. The unique capabilities of the carrier really affect the air threat. While antiair-capable guided-missile surface ships can help, only an aircraft carrier can cover the enormous area involved. Two CVVs provide more flexibility to respond to the potential threats than could one CVN.

If the situation called for massed carrier air-power, two CVVs could operate together. They could operate simultaneously or could split the duties. For instance, one carrier could operate as a strike carrier while the other provided fleet air defense. Also, two ships would also complicate the threat's targeting solutions: damage to one CVV would not eliminate the force as would damage to a single CVN. The CVV was not to be an austere carrier; it was a small, "high-end" ship.[14] Secretary Brown stated:

> ... that numbers of ships, the size of the fleet, and the ability to meet our commitments around the world simultaneously, instead of on a time-sharing basis, are important. It is an effort to arrest the trend that has cut the size of our Navy in half.[15]

Finally, the administration tried to justify the construction of limited capability carriers with the argument that the new ship was replacing the *Midway*, herself a limited carrier. The Navy reluctantly designed and proposed a new medium carrier, the CVV. The first CVV would cost approximately 2.252 billion FY82 dollars. This was not significantly less than the currently budgeted CVN, Theodore Roosevelt (CVN-71), costing 3.5 to 3.7 billion FY80 dollars. The CVV had grown from a small, austere SCS to a mid-sized carrier with almost the capabilities of a *Nimitz*-class CVN.

Based upon Navy carrier operational experience with the smaller *Essex*-class attack carriers in the 1950's and 1960's, upon experience with conventionally-powered large-deck carriers in the Indian Ocean, and finally upon cost considerations, Congress did not support the proposal. Instead, they authorized another *Nimitz*-class carrier. President Carter vetoed the bill because it included the large-deck CVN.[16]

VSTOL SUPPORT SHIP--THE VSS

ADM Zumwalt's successor as CNO, ADM James L. Holloway III, planned on having an all-VSTOL aircraft force by the early 21st century. One new ship in his plan was a small carrier capable of operating an entirely VSTOL air

wing. This ship, called the VSS, was anticipated to be more able to handle VSTOL aircraft and have the speed to operate with the fleet, which the SCS could not. A concurrent study by Naval Air Systems Command called for:

> ... three generic VSTOL air frames which would fill all sea-based aviation requirements, and which, it was hoped, would enter service in the late 1980s or early 1990s; VSTOL A (utility, e.g. ASW and AEW), B (supersonic fighter/ attack), and C (LAMPS III replacement).[17]

Development of the VSS continued on to a conceptual design. From late 1974 through the end of 1975, Navy Ship Engineering Center produced about 50 designs for the VSS. The smallest design was only an enlarged SCS, capable of operating only VSTOLs and helicopters; the largest had catapults and arresting gear, capable of operating both VSTOL and conventional aircraft.

By the middle of 1976 a conceptual design only slightly larger than the SCS was ready; it could handle 16 large and 6 small ASW helicopters and four Harriers. Unlike the SCS, however, this ship would have two shafts and be able to steam at close to 30 knots.[18]

No funds were forthcoming in 1976, but in 1977 Congress directed that "the VSS be evaluated in comparison with other sea-based air platforms."[19] Then the design changed several more times. First, the air group was changed to twelve Type A (ASW), four Type A (AEW), six small ASW helicopters and four Harriers. Next, in August, the Navy directed:

> ... the VSS also be capable of supporting a marine-assault air wing; twelve Type A (marine assault), four CH-53 D/F helicopters, six AH-1T gunship helicopters and two UH-1Ns.[20]

In September, the Navy made two more air group changes:

> ... an ASW/AEW group (sixteen Type As for ASW, four Type As for AEW, four Type B fighters) and a revised marine-assault air wing (twelve Type As for marine assault, six Type As for fire support and command and control, and four CH-53 D/Fs - later CH-53Es were also to be operated).[21]

Since air wing size and composition is the largest determinate of ship size, these changes in the air wing necessitated revisions to the VSS design. The resulting design was called VSS II.

Neither of the VSS designs incorporated any special protective features. In late 1977, the Under Secretary of the Navy, James Woolsey, commissioned a design for a protected version, VSS III.[22]

In another view of the VSS, John F. Lehman, wrote in 1978:

> The role of the VSS should be to augment and strengthen other Task Forces. It should be built solely for support of Type A VSTOL (First generation) and helicopters, and should be used primarily as an ASW carrier. It could also support secondary missions of Marine amphibious assault and add additional AEW, tankering capability to a larger air wing... [23]

No Congressional support for funding the generic VSTOL designs was received, possibly because naval aviators opposed the plan. "One problem throughout was that neither Type A nor Type B VSTOL was well defined in 1977; indeed, neither type exists ..."[24] The possible air frame for the

Type A, the V-22 Osprey, is only now, in 1990, in development. The existing VSTOL, the AV-8A Harrier, has continued to develop. The AV-8B Harrier II approaches VSTOL B in capability and performance.

TABLE 3

VSTOL SHIPS

	SCS	VSS I	VSS II	VSS III
Displacement (Tons)	13,736	22,490	26,334	29,130
Length (Ft)	610	690	717	717
Beam (Ft)	80	133.5	166.5	178
Speed (Kts)	24.5	28	-	-
Aircraft	19	26	26	-

Source: Norman Friedman, U.S. Aircraft Carriers: An Illustrated Design History (Annapolis: Naval Institute Press, 1983), p. 353.

THE SEA HARRIER

The original concept of sea control carriers included limited capability aircraft to fill the limited ship's missions. Opponents to the SCS concept argued that no aircraft existed that were capable of supporting the concept. However, the Harrier proved a capable strike aircraft during the Falkland Islands crisis. In addition, the Harrier has evolved into two new versions quite capable of filling the requirements of the SCS concept.

The British *Invincible*-class carriers operate the Sea Harrier FRS (Fighter, Reconnaissance and Strike) Mk. 1 VSTOL aircraft. Although the Harrier had flown from carriers several times since 1963, the Royal Navy became interested in it only after the government announced that

their large-deck aircraft carriers would not be replaced. This created the requirement for a new aircraft to operate at sea with the helicopter force.

The Sea Harrier is a re-designed Harrier GR (Ground attack Reconnaissance) Mk. 3 of the Royal Air Force. The naval version has a radar system installed in the nose to give it a fighter capability. The FRS-1 airframe has a 90 percent commonality with the GR-3, but the avionics are 90 percent new. The first Sea Harrier order was placed in 1975.[25]

During the Falkland Islands conflict, the Sea Harriers "concentrated on air defense, deck alert and reconnaissance" while RAF Harriers (GR3's) operated in "ground attack and radar suppression" roles, with a total of 28 Sea Harriers and 14 Harriers employed; both operated with Sidewinder air-to-air missiles.[26] In addition, the Sea Harriers performed ground attack and strike operations, prior to the arrival of the RAF Harriers, and limited ASW sonobouy laying.[27]

A new model of the Sea Harrier, the FRS-2, is being tested now. The FRS-1 radar lacks a look-down capability and "were unable to pick up aircraft flying beneath them"[28] during the Falklands fighting. The new FRS-2 radar has a look-down/shoot-down all weather fire control radar, further improving its capability as a fighter. The FRS-1 can carry the Sidewinder missile, with a range of about 19 km. The FRS-2 can carry the new AIM-120 Advanced Medium Range Air-

to-Air Missile (AMRAAM) with a range close to 74 km.[29] While one FRS-1 can cover 1,134 square kilometers using only Sidewinder missiles, one FRS-2 can cover 17,203 square kilometers using AMRAAMs.

In 1983 VADM Lyons, commander of NATO's Atlantic Strike Fleet, commented:

> Sea Harriers fit well into NATO's defense in depth concept and had been doing an outstanding job integrated with F-14's on CAP [Combat Air Patrol] during [Exercise] Ocean Safari 83.[30]

THE HARRIER II

The AV-8B/GR-5 Harrier II is a derivative of the original Harrier, with more thrust for both vertical (VTO) and short (STO) take-offs, a more efficient engine and additional wing stores stations. While the Harrier has a maximum take-off payload weight of approximately 6000 pounds, the Harrier II's is 6750 lbs for VTO and 17,000 lbs for STO. This STO maximum payload weight compares very favorably with the U.S. Navy's medium attack bomber, the A-6E, of approximately 18,000 lbs.[31] The Spanish Navy currently operates the Harrier II in a naval role.

ALTERNATIVE CARRIER--THE LHD

The VSS design, although not pursued further, still remains an option.[32] Another option is the aviation-capable amphibious assault ship. The Navy currently has thirteen, in three classes, in commission and several more building.

In 1981, the USS *Nassau* (LHA-4) operated with an air group of 20 AV-8As. With this second operation of an amphibious assault ship, the Navy proposed to Congress:

> ... a "Dual Path" future plan ... build the 15 CVBG's; second, augment the CVBG with LHD class ships in the convertible Sea Control mode. With the lessons learned from the LHD/VSTOL operations the Navy could make a better assessment of the best course for carrier aviation after the turn of the century.[33]

The newest amphibious assault ship is the LHD, an amphibious assault ship (multi-purpose). While the VSS was also called LH-X/VSS at times, to signify a second role as an amphibicus assault ship, the LHD is an amphibious assault ship with a secondary sea control mission. She can carry an air group consisting of twenty AV-8B Harrier IIs and six LAMPS III helicopters instead of the normal amphibious assault air group. A sea control air group eliminates the ship's ability to conduct an amphibious assault.[34]

While sea control has a direct application to amphibious assault--an assault can't happen without control of the area--the ship's primary mission remains amphibious assault. The switch to a sea control role will require about 15 to 30 days in port.[35] Consequently, the Navy can have an amphibious assault ship or a small carrier, but not both at the same time. The Navy would be better advised to build a small carrier--even use the LHD design--and use the LHD as only an amphibious assault ship. The Navy intends to test sea control concepts on the LHD's, similiar to the tests conducted on the *Guam* in the 1970's.

STILL NO SMALL CARRIER

Norman Friedman wrote in 1983:

> The central issue remains the success of advanced VSTOL aircraft, which for more than two decades has been just over the horizon. In most of these studies a VSS force capable of providing an air effort equivalent to that of a CV force is much more numerous and also more expensive, since each VSS requires much of the electronic suit of the larger ship. However, particularly when life-cycle costs are included, the air wing dominates carrier cost. ...
>
> The other central issue is vulnerability. No small ship is likely to be as survivable as a large one. However, in the face of nuclear weapons, ... it can be argued that the VSS force can preserve a larger fraction of its air power against a given level of attack. It is also often argued that, given their independence from catapults and arresting gear, VSTOL aircraft aboard a large carrier can greatly reduce that ship's vulnerability to disabling damage from conventional hits.[36]

John Lehman wrote in 1988:

> ... air superiority is essential to modern warfare, and the smaller-size carrier is restricted in all capabilities.... small carriers lack the speed and endurance of the big deck; the poor seakeeping qualities ... curtail flight operations as much as 30 percent of the time; small deck areas limit ... aircraft in performance as well as in numbers; the reduced volume ... limits weapons mix and storage capability ... bigger is better for carriers just as it is for supertankers. ... the large-deck carrier was able to sustain far greater combat damage and continue operating due to built-in redundancy as well as superior damage-limiting capabilities.[37]

Several attempts were made in the 70's to build smaller carriers, either at the expense of or in conjunction with large carriers. Proposals included replacing conventional air groups entirely with VSTOLs. Many believe that the powerful naval aviation and nuclear power communities are hiding the advantages of smaller and less expensive carriers.[38]

The above quotes point to a more important question: what is the mission of a small carrier or sea control ship? The issues include: the viability of the VSTOL aircraft and the ability of the smaller ship to withstand damage. As John Lehman points out, the smaller carrier can't compete with the large carrier in size, flexibility, damage sustainability and ability to operate in rough weather. The response to his discussion is: so what? The small carrier wasn't and isn't designed to replace the large-deck carrier in the strategic power projection role. The small carrier was and is to replace the large-deck carrier in the less demanding--but not undemanding--open ocean escort role.

The entire premise of the small carrier is that the Navy will never have enough large-deck carriers to perform its missions around the world. If a Task Force commander is offered the services of a large or a small carrier, the prudent commander will pick the large carrier. If the choice is between a small carrier and no carrier, the obvious choice is the small carrier. The original intent of the Sea Control Ship was to provide a means of getting more carrier-based aircraft at sea, for the critical job of air superiority previously described by John Lehman.

There will be situations when the services of a large-deck carrier would not be required. The small carrier is an alternative to not having enough. Friedman also believes:

> ... continuing Congressional interest in smaller types (such as the VSS) is unlikely to bear fruit for some time, if at all. Describing the LHD as a secondary power-projection ship is, for the moment, a sop to the critics. As long as there is no viable VSTOL AEW aircraft, the VSTOL carrier is unlikely to displace her big sister, as the Falklands Crisis appears to show.[39]

While many believe that no viable VSTOL AEW aircraft exists, the Navy had an AEW helicopter as early as the 1950s, the Sikorsky HR2S-1W, an HR2S/H-37 cargo and troop carrying helicopter with a powerful airborne radar, the AN/APS-20E, mounted in the nose.[40] After the Falklands Crisis, the British also developed an AEW helicopter, the Sea King HAS2A.

CURRENT SMALL CARRIERS OF THE WORLD

The Navy has designed several small carriers since the demise of the High-Low concept but never built one. The designs ranged from a nuclear-powered carrier, only slightly smaller than the existing large-deck carrier, to a small helicopter carrier. None of these designs have satisfied everyone. To procure any equipment, Congress, the administration and the Navy must agree that the item is necessary and capable before the Navy can ever receive it. Consequently, the Navy has not built a small aircraft carrier since the end of World War II.

While the U.S. Navy has not built any small carriers, the British, French, Italian, Spanish, and Soviet navies have. These navies do not necessarily have the missions, money, needs, or time to build a U.S.-style large-

deck carrier. Nevertheless, capable designs and ships have been produced. International designs fall into two categories: small "low-end" carriers, designed for sea control, and small "high-end" carriers, designed for both sea control and power projection. The British, Italian, and Spanish navies have small "low-end", the French small "high-end", and the Soviets a mixed force.

TABLE 4

CURRENT SMALL AIRCRAFT CARRIERS

CLASS	STANDARD DISPLACEMENT (Tons)	LENGTH (Meters)	AIRCRAFT
Invincible	19,960	206.6	22
Harrier Carrier	6,000	~137.5	8
Vickers - VAC	13,200	184	var
Clemenceau	32,700	265	40
PAN	39,680	261.50	40
Garibaldi	13,139	180.2	16
Principe de Asturias	15,150	195.1	20
Kiev	43,000	273	26-30
Tbilisi	65,000	300	60

Sources: Jean Labayle Couhat, ed., Combat Fleets of the World 1986/87 (Annapolis: Naval Institute Press, 1986), p. 115+; CAPT William H. J. Manthorpe, USN (Ret), "The Soviet View," U.S. Naval Institute Proceedings 116, No. 2 (1990), p. 118; Norman Polmar, "The Soviet Navy: Continuing Warship Construction," U.S. Naval Institute Proceedings 116, No. 1 (1990), p. 132.

BRITAIN

In 1966, the British government decided that the cost of the Royal Navy's proposed new large-deck carrier was too great and the cost of converting the large-deck carrier HMS *Eagle* to operate Phantom fighters unacceptable.

> The decision was made to reduce the range and capability of the Royal Navy aircraft carrier forces and bring it more in line with Britain's role in NATO.[41]

The Royal Navy designed the *Invincible*-class small carrier in the early 1970's to replace her last large-deck carrier, HMS *Ark Royal*, which they were about to decommission. Originally called the politically acceptable Through-Deck Cruiser, the design displaces less than 20,000 tons full load.

These ships were designed from the beginning to operate the Sea Harrier VSTOL fighter. They have no catapults or arresting gear. This allows them to be considerably smaller than previous British carriers.

The *Invincibles* originally carried 5 Sea Harriers and 9 Sea King ASW helicopters, later increased to 8 and 12 respectively or up to 22 Sea Kings only. These numbers can be further increased in an emergency.[42] It can also carry up to 960 Royal Marines, if required. Two ships were built to the original design with 7-degree ski-jump ramp and a third with a 12-degree ramp.[43]

During the Falkland Islands conflict, the HMS *Invincible* performed ASW and amphibious assault close air support missions. Four Sea Harrier fighters could launch in 50 seconds. The ski-jump ramp in the bow provided sufficient lift during aircraft launching that the carrier was not required to turn into the wind to launch aircraft, long a requirement of carrier operations.[44]

British shipbuilding firms have designed two small carriers: the Vosper Thornycroft "Harrier Carrier" of about 450 feet in length and 6,000 tons displacement (the size of a frigate) which would carry up to eight Sea Harriers or Sea King ASW helicopters[45]; and the "Vickers Versatile Aircraft Carrier (V-VAC)" of about 590 feet and 13,200 tons with a variable number of aircraft based on customer needs. The V-VAC was designed to be built to merchant ship standards, instead of military, to reduce construction time and cost; this design also allowed for rapid industrial mobilization.[46]

ITALY

The Italian Navy commissioned its own small carrier, the *Giuseppe Garibaldi* in 1985. At a full load displacement of 13,240 tons, she is the smallest of the contemporary small carriers, specifically designed for ASW operations in the Mediterranean. She can operate 16 large ASW helicopters or 10 VSTOL aircraft with one helo.[47]

SPAIN

The Spanish Navy's new aircraft carrier, the *Principe de Asturias*, is a modified SCS, the small carrier ADM Zumwalt proposed building in the early 1970's. The Spanish revised the design to suit their specific requirements, including a 12-degree ski-jump at the bow, a slightly larger flight-deck, equipment to support a

flagship, and four Spanish-designed and built Meroka antiaircraft gun systems. The installed electronic equipment (radar, Combat Information Center, etc.) enables it to:

> ... lead a task force that meets the country's strategic requirements and is capable of operating in the presence of serious threats.[48]

Since the *Principe de Asturias* is only a slightly modified SCS, she can perform the same missions for the U.S. Navy that the SCS would have, with or without the Spanish modifications.

FRANCE

The French Navy operates two small carriers. In addition, they are building a small nuclear-powered carrier and planning a second, to replace the first pair. All of these carriers are small "high-end" carriers, capable of launching the latest Conventional Take-Off and Landing (CTOL) aircraft, some with nuclear-weapons capability. The two existing small carriers, the *Clemenceau* and *Foch*, were built in the early 60's. They displace less than 35,000 tons full load and can operate up to 40 high performance CTOL carrier aircraft. These aircraft include the U.S. F-8E Crusader fighter (used by the U.S. Navy into the 1970's[49]) and the French-built Super Etendard strike aircraft, capable of carrying a nuclear bomb. In addition, these ships carry the Alize fixed-wing ASW aircraft.[50]

These small carriers are capable of carrying the latest U.S. carrier-type strike/fighter, the F/A-18 Hornet, giving them capabilities similiar to the largest U.S. carrier, albeit with fewer aircraft.

The French are building one and planning a second nuclear-powered aircraft carrier, the Porte-Avions Nuclear (PAN). These new carriers, displacing less than 40,000 tons, will operate 35 to 40 CTOL or possibly, later, VSTOL aircraft. These nuclear-powered carriers are an enlarged design of a small nuclear-powered helicopter carrier, the PH-75.[51]

SOVIET UNION

The Soviet Navy operates a mixed force of five aircraft carriers. The four *Kiev*-class sea control carriers operate very limited capability Vertical Take-Off and Landing (VTOL) aircraft and helicopters. The small *Tbilisi* "high-end" carrier operates slightly modified versions of their latest fighters and light attack aircraft.

The Soviets commissioned the *Kiev*, their first major aviation capable ship, in 1975. Three more ships of this class followed in 11 years. The exact size remains a mystery, but estimates range from 36,000 to 43,000 tons. Their mission is also not exactly clear, since the Soviets have classified them as both *Bolshoy Protolovadochnyy Kreyser* (Large Antisubmarine Cruiser) and *Taktycheskoye Avionosnyy Kreyser* (Tactical Aircraft-Carrying Cruiser).

They have both offensive and defensive capabilities, with rockets, missiles, guns, helicopters, and VTOL aircraft.[52]

The *Kievs* have a large amount of space used for non-aviation equipment such as large surface-to-surface missile launchers. Compared to a U.S. style large-deck aircraft carrier, this space could be better used to increase the ship's aviation facilities. To the Soviets, this design may not be so wasted.[53] Former Commander-in-Chief of the Soviet Navy Admiral of the Fleet of the Soviet Union Sergei G. Gorshkov described the Soviet Navy's mission as:

> The projection of power of Soviet military power overseas in the context that in the future only naval forces would be able to guarantee Soviet state interests in the Third World. These countries are already vital to the West for ... resources, and are taking on increasing significance for the Soviet Union.[54]

ADM Gorshkov evaluated the German submarine campaign of World War II and concluded:

> ... the submarines did not receive support from other forces, and above all from the Air Force, which would have been able both to carry out the reconnaissance for the submarines and destroy ASW forces, as well as to operate against the enemy's economy by attacking his ports and ... shipping industry, not to mention attacks against ships at sea. The effectiveness of German submarine employment ... was considerably reduced for these reasons.[55]

The new carriers, along with the new Soviet surface ships, contribute to the mission of "protect the strategic missile submarines and to provide 'combat stability' by supporting attack submarines."[56]

The Soviet's first true aircraft carrier, the *Tbilisi*, started sea trials in 1989. She represents a

quantum leap in Soviet carrier technology, operating slightly modified CTOL aircraft using a ramp at the bow to launch and arresting gear to recover them. She carries approximately 60 of the latest MiG-29 Fulcrum and Su-27 Flanker fighters, Su-25 UT Frogfoot light attack aircraft, Ka-27 Helix helicopters, and possibly An-74 Madcap early warning aircraft. According to the present Commander in Chief of the Soviet Navy, Admiral of the Fleet Vladimir N. Chernavin:

> The VTOL deck-borne aircraft [in the *Kiev*] were attack aircraft, but now we needed to have fighters on our carriers - that is, aircraft to assume the defense role... We see their main role as platforms for fighter aircraft able to provide long-range cover for our vessels when shore-based fighters are unable to help...[57]

The *Tbilisi* represents a possible design for a small "high-end" carrier. She can operate the latest, large, Soviet CTOL aircraft, similiar to the U.S. F-14 Tomcat fighter.

CONCLUSIONS

After failing to get funding for the SCS, the Navy designed another small carrier, the CVV. Larger and more capable than the SCS, the CVV was really an attempt to design a smaller, less-expensive large-deck *Nimitz*-class CVN. Although smaller than the *Nimitz*-class, the initial unit would cost as much as the CVN. The administration supported the new ship while Congress did not. When

Congress substituted a new CVN for the two CVVs, President Carter vetoed the bill.

The next attempt to design a small sea control carrier resulted in the aviation or VSTOL support ship (VSS). The administration failed to budget this ship primarily because of aircraft problems. Finally, the Navy redesigned the new amphibious assault ship (LHD) to include a sea control capability. In 1989, after nearly twenty years, the Navy finally received its first LHD, with the (secondary) mission of sea control.

One complaint was that the ship's proposed aircraft were inadequate; the VSTOL was not developed sufficiently to design a ship around one. The performance of the U.S. AV-8B Harrier II and the British Sea Harrier closely equals that called for in the VSS studies. Secondly, the ship would have no AEW aircraft. One such aircraft, a helicopter, existed in the U.S. in the 1950's. Finally, the V-22 Osprey can fill the role of the utility VSTOL (ASW and AEW.)

While the U.S. Navy designed but didn't build any sea control carriers, five navies did. The ships range from the relatively large *Tbilisi*, similiar to the CVV, to the small *Giuseppe Garibaldi*, a SCS. While built to other navies' missions, budgetary limitations, and shipyard construction capacities; our Navy could design and build one just described if the Navy, the administration and Congress agreed on the ship's missions, capabilities and limitations.

Some Congressmen, analysts, and naval officers believe that "the price they paid in carrier function was probably unacceptable."[58] They argue that the small carrier cannot strike targets ashore with the same power as the large-deck carrier. Although correct, they miss the point. A small carrier is not supposed to be the Navy's primary power-projection carrier; it is designed to protect convoys, amphibious shipping, and the like from the open-ocean air and submarine threats.

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CHAPTER 4

THE EXPERIENCE WITH SMALL AIRCRAFT CARRIERS IN WORLD WAR II

This chapter evaluates the experience with small carrier design, procurement, and operations in World War II. World War II is used as it is the only time when the U.S. Navy has both large and small carriers operating simultaneously during combat. The World War II experience shows us how large and small carriers could operate together in the next war.

IN THE BEGINNING

From the very beginnings of Naval Aviation, the naval community debated the issue of optimum aircraft carrier size. Prior to the construction of the first carrier, the Navy had designs ranging from small to large for that era. The small carrier design became the USS *Langley* (CV-1), a converted collier, while the large became the USS *Lexington* and *Saratoga* (CV-2 and 3), converted battle cruisers.

The major limiting factor on carrier construction between the World Wars was the Washington Naval Treaty,

which limited individual carrier size and the Navy's aggregate carrier tonnage. The second limiting factor was the reluctance of the administrations and Congress to spend money on defense.

The second small carrier, the USS *Ranger*, was the first built-for-purpose aircraft carrier in the Navy. After commissioning the USS *Lexington* and *Saratoga* (at 33,000 tons, very large ships for their day) the Navy built the *Ranger*, only 14,500 tons. The original plan was to build five of these ships, for two reasons: the desire to build the maximum number of carriers from the remaining Washington Naval Treaty tonnage limitations, and Congressional budgetary restrictions.[1] Although the design could support about 80 planes, the Navy judged the ship as too small, too slow, and ineffective. The Navy decided that the minimum standard sized carrier would be 20,000 tons.[2]

PLAN ORANGE AND THE MOBILIZATION CARRIERS

Between the World Wars, the Navy conducted studies of the next anticipated conflict, a war with Japan. The resulting naval war plan, Plan Orange, envisioned a naval war with extremely long sea lines of communications to get forces from the West Coast to the anticipated operating areas. The Navy concluded that the existing number of carriers would be insufficient to prosecute a war in the Pacific. With the Washington Naval Treaty restricting the number and size of aircraft carriers, the war plan included

provisions for the conversion of merchant ships into second-line aircraft carriers, as a legal means to circumventing these restrictions. The resulting design, called XCV, was, therefore, a mobilization preparation.[3]

> As early as 1935 the Navy ... had been considering the conversion of ten fast passenger ships ... for quick action when the ... emergency required the conversion of merchant type vessels to auxiliary aircraft carriers.[4]

In 1938 Vice Admiral Ghormley, of Navy War Plans, conducted an analysis of the situation and determined that the Navy's fleet would be under-employed ferrying aircraft to the operating areas. In addition, he proposed that the small carriers operate as ASW ships for offensive operations "locating and attacking submarines in the areas of shipping routes" and defensive "through continuous air patrols flown by carriers in company with the convoy."

> In fleet operations small carriers would form part of the advanced scouting groups, where their reduced vulnerability in loss of plane strength, their increased gun power, and the shorter time required to get planes into the air and back on board will permit them to operate efficiently ... They [will] supply information to our striking units, including our large carriers, that will permit the latter to stroke [sic] enemy units with maximum power..."[5]

The major differences between these mobilization designs and the small carriers of World War II was that the mobilization carriers were, in fact, small fleet carriers as opposed to the future austere escort carriers.[6]

THE SMALL CARRIERS OF WORLD WAR II

William T. Y'Blood, a small carrier historian, wrote in 1983:

> In May, 1927, Lieutenant Commander Bruce G. Leighton wrote an impressive paper on light carriers. His forecast of possible use for these smaller vessels ... foresaw the use of these ships in *antisubmarine warfare*, fleet operations support, reconnaissance, attacks on enemy warships, and the reduction of enemy shore bases... small carriers could operate in groups, and the destruction of one would not be a serious setback.[7]

By the late 1930's, the British Royal Navy concluded that it had too few large carriers to successfully carry out its missions. The threat from the bomber appeared great, especially for the Royal Navy, "uneasily conscious that it would have to fight the large shore-based air forces of Germany and Italy. Aircraft carriers were one answer..."[8] Additionally, prospects of getting new large carriers in commission quickly seemed remote. Finally, even if all of the programmed new carriers were received, that number was still too few to carry out its missions.

> As German air attacks mounted from captured bases in France began to threaten convoys in the Atlantic, the idea of the fighter carrier emerged in the form of the *Audacity*, decked over and fitted with two arresting wires and a barrier... she was intended from the first to operate high-performance aircraft.[9]

In the fall of 1940, the Director of Material for the Royal Navy's Fleet Air Arm, CAPT Matthew Slattery, RN, requested that the Admiralty "fit the simplest possible flight decks and landing equipment to suitable merchant ships..."[10] The Royal Navy needed more aircraft at sea to face the German Luftwaffe. The solutions were novel.

EXPEDIENCY--THE CAM

One solution was to mount an aircraft catapult on the deck of a merchant ship, the Catapult Aircraft Merchant (CAM). Although able to carry aircraft at sea in the immediate vicinity of a convoy, the plane could be launched only, not recovered. The pilot was forced to bailout near a friendly vessel and be picked up. The plane was, of course, always lost. Operating this way in the cold North Atlantic was horrible, yet 50 such vessels were outfitted.[11]

SECOND EXPEDIENCY--THE MAC

With deliveries of lend-lease escort carriers to the British slower than anticipated and German submarines sinking ships at an alarming rate, the British converted two cargo ships into small aircraft carriers, called Merchant Aircraft Carrier (MAC). These were merchant ships with a flight deck mounted above the main deck. The ships retained their original carrying capability while also providing a deck for aircraft operations. While only a few aircraft could be carried, this method did get aircraft to sea to protect merchant convoys with some assurance of recovering the plane and pilot. A total of six cargo ships and eleven tankers were converted and operated throughout the war.

> MACs made 170 round trips with Atlantic convoys, 4,447 days at sea, 3,057 of them in convoy, their aircraft flying on 1,183 days ... No MAC-ship was sunk, and of 217 convoys enjoying their protection, only one was successfully attacked by U-boats.[12]

ULTIMATE SOLUTION--THE ESCORT CARRIER

The ultimate solution to putting aircraft at sea was the total conversion of a merchant ship to a small aircraft carrier. The first such ship, the captured German blockade runner *Hannover*, became the HMS *Audacity*.[13] Even though the ship was not very large and few aircraft could be carried, the *Audacity* was a complete success. The major drawback was the limited number of merchant ships. The British Merchant Marine was hard-pressed to keep ships at sea with the large numbers of ships sunk by German air and submarine attacks. Now the Navy wanted to take merchant ships and turn them into aircraft carriers! The MAC at least was still able to carry cargo.

> As early as January 1941, well before the *Audacity* had been completed, the Royal Navy requested more ships of her type, ... this request was rejected because they were too valuable as fast merchant ships... [14]

The logical answer was build a small aircraft carrier from scratch, yet problems arose immediately. British dockyards were full of ships being repaired or built to replace losses and increase inventories. Space was available to build these ships in only one location: the United States.

> In May 1941, the British Battle of the Atlantic Committee observed that 'a great advance will have been made if our convoys can carry their own cooperation aircraft,'... the *Audacity* was torpedoed during a long convoy battle in December, but her success inspired the ... Committee to suggest five more conversions plus six to be ordered in the United States under the Lend-Lease Act.[15]

Prime Minister Winston Churchill of Great Britain asked President Franklin D. Roosevelt if the U.S. would build these small aircraft carriers in the U.S. and lend-lease them to the British. The President recommended to the CNO that the U.S. Navy convert suitable merchant ships into auxiliary carriers for anti-submarine warfare (ASW) escort work. Any such ship built should have an identical copy built for the British.[16]

> Speed of construction was essential, as the president continually pointed out to the chief of naval operations. Nevertheless, the Navy believed that it would take a year and a half to convert the ships. Roosevelt was in no mood for this timetable and told the Navy that any plan that would take more than three months would be unacceptable.[17]

As early as December, 1940, RADM William Halsey, the commander of carriers in the U.S. Fleet, wrote the CNO:

> If the USA is drawn into this war, the Navy's six big carriers will have to go on active duty immediately, leaving no means of training carrier pilots or transporting planes. You must find some suitable merchantmen and convert them into auxiliary carriers.[18]

Still, the U.S. Navy was not keen on the idea. It had determined in the 1930's that the small carrier was not as effective as the large one and that the Navy had the best large carrier in the world on the drawing boards--the new *Essex*-class. Since the small carriers had proven to be incapable of performing to the Navy's satisfaction prior to the war, the Navy was not convinced that the small carriers would be beneficial in the war.

The new marvels had one major drawback: the first was not expected until late 1942 or early 1943. Until then,

the Fleet was left with the seven existing carriers. One of them, the USS *Ranger* (CV-4), was already considered too slow and too small to operate effectively in the Pacific, the major theater of operations for the U.S. Navy.[19]

The President was convinced that the Navy needed more carriers, quickly. Because of Presidential interest, the Navy converted a merchant ship into the "small" aircraft carrier USS *Long Island* (AVG-1).[20] In accordance to instructions, another merchant ship was converted into a carrier for the British, the HMS *Archer*.[21] The *Long Island* was soon followed by more, converted from both cargo ships and oilers. Finally, shipbuilders introduced built-for-purpose designs.

The CVE construction and conversion program originally called for 54 ships. The President, however, believed:

> ... that even more escort carriers were required to cope with the ongoing ASW disaster ... this ... peaked well after the decisive engagements of the spring of 1943.[22]

Eventually, 115 escort carriers were built for the U.S. Navy with 38 more turned over to Britain.[23] The small carriers operated as ASW escorts, close air support carriers for amphibious assaults, general air support platforms and replacement aircraft ferries.[24] In January, 1943, three escort carriers constituted 60% of the Pacific Fleet's carrier force.[25]

The number of aircraft carried onboard was never very large, usually around 21. The flight deck was small by comtemporary standards and the "Baby Flat-tops" usually carried the older model fighter, the F4F/FM Wildcat. Although no longer considered "front-line" for Pacific Ocean duties, the Wildcat was adequate for convoy escort duties. The German air threat to Allied naval forces in the Atlantic was not from high-performance fighters or strike aircraft but primarily from long-range reconnaissance aircraft, which the Wildcat was more than capable of defeating.

The last version, the Eastern Motors FM-2, was specifically designed to operate from the small-deck CVE.[26] The small carriers could operate the latest types of fighters and strike aircraft, including the Corsair and Hellcat. The British operated F6F Hellcats from their small carriers while the U.S. used F4U Corsairs.[27]

The escort carriers were not designed to be "Fleet" aircraft carriers. They could not operate many aircraft and could not take a lot of damage. The standing joke of the Pacific Fleet was that CVE stood for "Combustible, Vulnerable and Expendable."[28] Yet, those same ships held off a large Japanese force of cruisers and battleships at the Battle of Leyte Gulf.[29]

Why were the pre-war mobilization carriers, the XCVs, not built and the CVEs built? The XCVs, really second-line fleet carriers, were considered too much carrier--"gold plated"--while the CVEs were the most austere

carrier available that could still perform the missions. Those missions, convoy air and submarine defense, implied:

> ... a lower level of risk than a fleet carrier might encounter and, coincidentally, a lower level of individual aircraft performance. In this sense the CVEs formed the lower (and the *Essexes* the upper) end of an implict "high-low" mix, the decendants (CVS and CVA) of which shaped U.S. carrier policy into the seventies. The CVE story also illustrates the conflict between optimum design for operation and the optimum design for quick production.[30]

> A subtheme is the way the CVE mission shifted over time to include aircraft transportation (a role envisaged before CVEs were ever considered combatants) and a close-support role which ultimately required aircraft approximating those aboard a full fleet carrier. Indeed, the sophisticated CVEs produced at the end of the war were virtually slow versions of the CVL, and British CVEs operated as fleet carriers in Southeast Asia.[31]

THE LIGHT CARRIER

In addition to converted and built-for-purpose escort carriers, the U.S. Navy built another type of small carrier: the Light Aircraft Carrier (CVL). By end of the first year of the war, carrier losses and the unavailablity of the new *Essex*-class left the Navy with only two large carriers in the Pacific. More light cruisers were under construction than the Navy needed, while at the same time, carriers were in short supply. Since conversions to carriers had already been used successfully, the President directed that the Navy convert cruisers into carriers.[32]

Nine incomplete light cruisers were converted. A flight deck was placed atop the cruiser hull and aviation support facilities were added within. These ships could

carry about 42-45 aircraft. Since the hulls were designed for warships, these ships were faster and could survive more damage also. The basic soundness of the design is one explanation for the existence of one of those ships, the former USS *Cabot*, as the Spanish carrier *Dedalo* until the fall of 1989.[33]

THE SMALL CARRIERS PERFORM

Branded as too small and too slow for a Pacific Ocean scenario, the *Ranger* operated only in the Atlantic during the war. During the invasion of North Africa, with all of the remaining large-deck carriers operating against the Japanese in the Pacific, the *Ranger* and four escort carriers supported the landings, as would their bigger cousins in the Pacific.[34] By 1945, the *Ranger* had been reduced to duty as the Navy's training carrier.[35]

The four *Sagamon*-class escort carriers, converted oilers with all fuel tanks left intact, impressed planners during the North Africa invasion. One report stated that the escort carriers:

> ... are valuable additions to the fleet at this critical time when every escort is being made to augment the number of carriers available ... They can handle a potent air group and can operate under most weather conditions. Their speed is insufficient, but the fact that they are independent of fuel worries is a great asset in this war of long distances.[36]

In 1944, during Operation Anvil, the invasion of Southern France, nine Allied escort carriers, seven British

and two U.S., provided air support, aerial artillery spotting and night fighter support for the assault.[37]

The major employment of escort carriers during the war was in the anti-submarine war raging in the Atlantic. The first escort carrier committed, the HMS *Audacity*, escorted only three convoys between Gibraltar and the British Isles before being sunk by a submarine.[38] The *Audacity* was so valuable that, upon her sinking, Kommodore Karl Doenitz, *Befelshaber der U-boote*, declared "The sinking of the aircraft carrier is of particular importance not only in this case but also in every future convoy action."[39]

In the Battle of the Atlantic, U.S. escort carriers were mostly used in conjunction with escort destroyers or ASW modified destroyers in hunter-killer groups for offensive operations against the U-boats.[40] During the summer of 1943, the escort carriers sank an average of one U-boat a week, with half being the vital German supply submarines, the *Milch Cows*.

These *Milch Cows* had refueled up to 400 submarines in the Central Atlantic before the carriers went after them. The history of the U.S. Tenth Fleet, responsible for Atlantic Ocean ASW, reported:

> Without the refuelers, neither prolonged independent cruise nor extended convoy operations were possible to the [smaller boats] that made up the vast majority of the U-boat fleet.[41]

The destruction of this German supply system in the Central Atlantic forced them to abandon this area sooner

than planned.[42] By the end of that year, the small carriers had demonstrated excellent offensive potential and had forced the Germans to change their operational patterns, doctrine and tactics. The Germans were now reacting instead of acting, since:

> ... the disposition and habits of USN CVE groups were pressing concerns which necessitated revisions of current orders on the defense situation in an effort to determine where and when U-boats might safely surface.
>
> But there were few places left where a U-boat might surface undisturbed. Also, by the latter part of 1943 patrols were often ineffective because of the time the boats had to spend underwater to escape the attention of the seemingly omnipresent aircraft.[43]

Approximately 177 German U-boats were sunk by U.S. forces alone. The ASW hunter-killer groups accounted for 31 percent of the total sinkings. CVE aircraft squadrons sank 30 submarines, the escorts 19, with one capture (the U-505) and four sinkings shared.[44]

The British escort carriers operated more closely to the convoys than did the U.S. They viewed the protection of the convoys as the first priority, the destruction of enemy submarines as the secondary. They used the carriers' highly mobile aircraft to operate defensively during the convoy battles. In addition, the threat to the northern convoys was as much from German land-based air attack as submarine.[45]

Since the end of the war, a rather gentlemenly argument arose over these tactics. Although the U-boats were defeated in the Battle of the Atlantic by the summer of 1943, German submarine construction continued to increase

through 1944. The U.S. opinion was that any submarine not destroyed would come back to try again. The U.S. tactic of using ASW escort groups offensively seeking and destroying enemy submarines was possible because of Allied code-breaking success with Enigma. The intelligence gained from Enigma enabled the U.S. Navy to know where the U-boats were.[46]

In summing up the contributions of the escort carriers in the Battle of the Atlantic, RADM Samuel E. Morison stated "Escort carrier groups were probably the greatest single contribution of the United States Navy to victory over enemy submarines."[47]

In the Pacific, the CVEs provided close air support for amphibious assaults, freeing the larger CVs to seek and destroy any enemy naval forces in the area. In addition, they operated as aircraft replacement ferries and as ASW escorts for the Pacific Fleet logistics groups. The CVEs even engaged the Japanese surface force of battleships and cruisers during the Battle of Leyte Gulf.[48]

One CVE was in commission when the Japanese attacked Pearl Harbor. Another 115 were built during the war. Of these, 38 were turned over to Britain and 9 were never completed. An additional 5 were built in Britain,[49] and 9 CVLs were converted from light cruiser hulls.[50]

CONCLUSIONS

From the very beginning of Naval Aviation, the optimum size of the aircraft carrier was a matter of intense discussion. The Navy determined that the optimum size was about 20,000 tons displacement, based on operational experience with the large *Lexington*-class and small *Ranger*.

After the Great War, the Navy developed war plans for the next anticipated conflict--a war in the Pacific with Japan--and concluded that the fleet would require more aircraft carriers. Furthermore, Washington Naval Treaty restrictions limited the number of aircraft carriers that could be built. Consequently, as early as 1927, plans were prepared to convert merchant ships to auxiliary aircraft carriers.

At the start of World War II, the British Royal Navy, facing a large, land-based enemy air force, planned and converted merchant ships into aircraft carriers for trade route protection against enemy air attacks. Because of a shortage of suitable merchant ships and shipyard facilities, they asked the U.S. to build the ships and lend-lease them to the Royal Navy.

President Roosevelt directed the U.S. Navy to build the carriers not only for the British, but also for the U.S. The resulting ships were designated the escort aircraft carrier (CVE). Later, with a shortage of large-deck carriers and a large number of cruiser hulls available, the President again directed the Navy to convert ships into

aircraft carriers, these becoming the light aircraft carrier (CVL).

The small carriers were rapidly built from scratch using an assembly-line process or converted from suitable merchant ships. The Navy started the war with only one escort carrier; 115 escort and 9 light carriers were built in the U.S. during the war with more started and not completed. In contrast, the Navy started with seven large carriers and completed fewer than two dozen.

The small carriers operated in all theaters of the war. They tipped the balance in the Allies' favor in the critical Battle of the Atlantic. German submarine production increased until the middle of 1944. Without the escort carriers, the Battle of the Atlantic could have ended disastrously for the Allies.

In the Pacific, the escorts operated in many missions, providing valuable close air support for amphibious assaults, merchant ship protection, aircraft ferries, and ASW. At one point, they constituted the bulk of the carrier force in the Pacific.

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CHAPTER 5

CONCLUSIONS

The present carrier force is too small to adequately support the Navy's missions world-wide. There will never be sufficient time or resources to build the number of carriers needed in a major conflict. The Navy has entered a time similiar to that after World War I, with "peace in our time" and no agreement on the possible threat or threats to the United States or our interests around the world. After that war, even in a possible future war in one area against one potential enemy, the forces available could not respond to the threat. The best possible alternative to not being able to respond to a potential threat in the future is to be ready now. With limited time and resources available, the best choice is to build both the large-deck and small-deck carrier.

The Navy needs to re-evaluate the small sea control aircraft carrier. The Navy needs to accept that the SCS is not a large-deck carrier; that the small carrier is good only for sea control. The addition of sea control ships would maximize the Navy's ability to carry out its missions throughout the world.

SUMMARY

The relative merits of small and large-deck carriers have been debated inside and outside the Navy since the very beginning of naval aviation. In the 1920's, operations with both sizes of carriers demonstrated to the Navy that the large-deck carrier was the most effective in terms of: individual carrier size and aggregate force limitations of the Washington Naval Treaty; airwing size and composition; aircraft growth potential; operability in rough seas; and damage that could be sustained by the ships. This view remains the keystone to the Navy's carrier construction philosophy today.

In the 1930's, the Navy discovered that in the probable war scenario of the era, against Japan in the Pacific, they would have an insufficient number of carriers. Because of time, naval treaty, and budgetary limitations, the only possible way to procure new carriers was the conversion of suitable merchant ships to auxiliary aircraft carriers. In spite of these pre-war studies and the support of naval aviators like RADM Halsey, the Navy did not want small carriers.

All of the small carriers in World War II were built as a result of Presidential directive, not of conviction by the Navy. These small carriers served well in all theaters of the war and proved decisive in the Battle of the Atlantic. The small carriers could be turned out in as

little as six months compared to an average of three years for the large-deck carriers. Over one hundred small carriers were built compared to less than twenty of the large.

After the war, the small carrier's slow speed and inability to operate the newer and increasingly larger aircraft spelled the end of their front-line service. However, by the late 1960's and early 1970's, the introduction of the Harrier VSTOL aircraft and the development of the heavy ASW helicopter changed the equation in favor of the small carrier in the limited sea control role. In an effort to reverse the decline in carrier force numbers and to take advantage of the new aircraft technology, the CNO proposed in 1971 building several small carriers to complement the small number of large-deck carriers.

THE NEW AIRCRAFT

From the early 1950's onward, large, sonar-equipped ASW helicopters were recognized as a viable means of detecting and, perhaps more importantly, of keeping contact with a submarine. In particular, they could operate active (dipped) sonar randomly around the protected ship(s). While a submarine could detect and track a destroyer that was using active sonar, the helicopter could operate over a greater distance unpredictably. Also, a submarine-launched torpedo can't strike an airborne helicopter.

Although the first VSTOL was proposed in the 1950's, the first operational VSTOL, the P.1127 Kestrel, first flew from a carrier in 1963. The Harrier reached operational status in 1967. The requirements for a naval version, the Sea Harrier, included a radar system installed in the nose to give it a fighter capability. The first Sea Harrier order was placed in 1975.

A new model of the Sea Harrier, the FRS-2, is being tested with a look-down/shoot-down, all-weather fire-control radar. The FRS-1 can carry the Sidewinder missile, with a range of about 19 km; the FRS-2 can carry the new AIM-120 Advanced Medium Range Air-to-Air Missile with a range close to 74 km.[1] The Harrier II is a new model of the original Harrier, with more engine power and additional wing-stores stations. The Harrier II's maximum take-off payload weight is more than 17,000 lbs using a STO, a payload weight similiar to the Navy's medium attack bomber.[2]

THE SMALL CARRIER

The proposed new small carrier, called the Sea Control Ship, was designed from the beginning to be small, austere, and inexpensive. Eight could be constructed for the cost of one large-deck carrier at the time. These ships would conduct open-ocean ASW, convoy escort, and amphibious support operations, freeing the large-deck carriers for the strategic power projection roles for which they are best suited.

The Navy's evaluation of this concept demonstrated that the ship could perform the roles for which it was designed but not the missions of the large-deck carrier. The major limitation was the inability of the Harrier, originally designed as a strike aircraft, to operate as a local air defense fighter. This situation was resolved with the introduction of the British Sea Harrier fighter/ strike aircraft.

Although the Navy's testing and evaluation validated the concept of the modern small carrier, no such ship was built. Originally, groups within the Navy and Congress did not agree with the concept of a limited capability warship. Later, the Navy, two administrations, and Congress tried to get small carriers designed and built, but those three groups have never agreed to the missions or capabilities needed. No one had a clear idea of what they wanted--a replacement for the large-deck *Nimitz*-type carrier or a small carrier to complement the large-deck *Nimitz*-type carrier.

THE FUTURE

VSTOL aircraft will someday replace CTOL aircraft in the Navy. However, real advances in VSTOL technology will happen only when the Navy builds such a carrier, continues development and testing of the aircraft and concept. The situation today is analogous to that after World War I. The Navy wanted and needed an aircraft carrier to prove or

disprove the capabilities of the airplane and to advance technology. Even though it wasn't the ship the Navy wanted, Congress authorized and the Navy converted a collier into an aircraft carrier, the USS *Langley*, strictly to start developing and testing carrier aviation.

ISSUES

One common complaint about small carrier designs is that the aircraft are inadequate. Many naval officers complain that VSTOL aircraft are not sufficiently developed to design a ship around them. However, the performance of the Sea Harrier in Britain and the AV-8B Harrier II in the U.S. closely equals that called for in the VSTOL studies for the VSS. Detractors also say that type of ship would be unable to operate an AEW aircraft, yet an AEW helicopter existed in the 1950's, the HR2S-1W. The British also developed the Sea King HAS 2 A after the Falklands conflict. The utility VSTOL has evolved into the V-22 Osprey, now in prototype testing.

Some analysts, Congressmen and naval officers believe that with small carriers, "the price they paid in carrier function was probably unacceptable."[3] They argue that the small carrier cannot strike targets ashore with the same power as the large-deck carrier.

Although correct, they miss the point. A small carrier is not designed as the Navy's primary power projection carrier; it is designed to protect merchant

convoys, mobile logistic support forces, and amphibious shipping from the open-ocean air and submarine threats. These designs should not be compared to the *Nimitz*-class CVNs. They should be evaluated against their stated missions.

Building ships with a secondary sea control mission (the LHD) gives everyone a false sense of security. The LHD can either operate as an Amphibious Assault Ship, Multi-Purpose, or as a Sea Control Ship; it can not operate as both simultaneously. If the LHD can fill the mission of a SCS, then the Navy should build more of them specifically for that purpose and call them something else (e.g. CVS, CVL, SCS.)

Small carriers, using modern VSTOLs and helicopters, can conduct limited anti-submarine, anti-surface, anti-air, and amphibious warfare support operations. They can't conduct fleet air defense or strategic power projection afloat or ashore. What everyone forgets is that these ships aren't designed to conduct those operations. Harriers can't replace the modern Tomcat fighters or Intruder strike aircraft.

Small carriers with VSTOL or derivative aircraft can effectively perform the sea control mission, freeing the large-deck carrier for the power projection mission. Small carriers cannot replace current large-deck carriers using present technology.

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